

# **WASTEWATER OPERATOR CERTIFICATION GUIDE**

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**Illinois Environmental Protection Agency  
Division of Water Pollution Control Wastewater**

**Operator Certification Guide**

The purpose of this guide is to provide information about the wastewater operator certification program. For ease of use, this guide is divided into the following sections:

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## **FAQ's (Frequently Asked Questions)**

- 1. Is the wastewater operator certification program mandatory or voluntary?**
- 2. The wastewater operator certification program is a mandatory program.** This means that each wastewater treatment facility in Illinois is required to be operated by a wastewater operator who is certified at or above the certification level required for the treatment facility. However, a **voluntary** certification program for **collection system operators** has been implemented. Since this is a voluntary program, it means that a certified collection system operator is not required to operate a collection system, although it is strongly recommended by the Agency.
- 3. How are wastewater treatment facilities classified in Illinois?**

Wastewater treatment facilities are classified as either domestic or industrial facilities.

Municipal wastewater treatment facilities are classified in one of four groups as follows:

- Group 4 Lagoon treatment systems. Group 4 facilities require a wastewater operator certified at the Class 4 or higher level (Class 3, Class 2, or Class1).
- Group 3 Fixed film processes and Imhoff tank systems with a design average flow (DAF) of less than 1.0 MGD, and all primary treatment systems. Group 3 facilities require a wastewater operator certified at the Class 3 or higher level (Class 2, or Class1).
- Group 2 Activated sludge systems with a design average flow (DAF) of less than 1.0 MGD. Group 2 facilities require a wastewater operator certified at the Class 2 or higher level (Class1).
- Group 1 All domestic wastewater treatment systems 1.0 MGD DAF or more, excluding lagoon systems and primary treatment systems. Group 1 facilities require a wastewater operator certified at the Class 1 level.

Group K Industrial wastewater treatment facilities require Class R certified wastewater operators. Group K facilities shall consist of industrial wastewater treatment works, pretreatment works, domestic wastewater treatment works owned and operated by industries, and spray irrigation that is collected and discharged.

- 3. What are the wastewater operator certification levels available in Illinois?**

Municipal:           Class 4 (lowest level)  
                          Class 3  
                          Class 2  
                          Class 1 (highest level)

Industrial (Class R): Facility-Specific  
General (Water Remediation)      Collection System Operator

**4. What are the eligibility requirements for each certification level?**

Class 4: 1 year wastewater operating experience **and** high school education or equivalent

Class 3: 2 years' wastewater operating experience **and** high school education or equivalent

Class 2: 4 years' wastewater operating experience **and** high school education or equivalent

Class 1: 6 years' wastewater operating experience **and** high school education or equivalent

Class R: Active supervision and/or operation of an industrial wastewater treatment facility

Collection System Operator: 1 year collection system operating experience **and** high school education or equivalent

All applicants must be able to read and write in English

**5. Are there any substitutions that can be used to help satisfy the eligibility requirements?**

Yes, For Class 1 applicants, minimum of 3 years hands-on and maximum of 2 years wastewater training course/college and maximum of 1 year each of non-wastewater courses, lab experience or collection system experience.

Class 2 applicants must have 2 years minimum of hands-on experience and maximum of 2 years of wastewater training course/college and maximum of 1 year each of non-wastewater training, lab experience or collection system experience.

Class 3 applicants must have 1 year minimum of hands-on experience and maximum of 6 months of wastewater training course/college and maximum of 1 year of non-wastewater training, lab experience or collection system experience.

Class 4 applicants must have 6 months of hands-on experience and maximum of 6 months of wastewater training course/college and/or 1 year of college in a course designed for wastewater treatment with hands-on training included. 3 months of lab or collection system experience will be allowed, but no non-wastewater courses will be recognized.

For collection system operator applicants, up to 6 months of hands-on experience and maximum of 6 months of training (3 months of collection system course or wastewater course) or 3 months of wastewater experience.

**6. What is a wastewater operator?**

A wastewater operator is a person who regularly makes recommendations or is responsible for process control decisions at a wastewater treatment facility. The term does not apply to persons whose duties are limited solely to laboratory testing or maintenance, or to other persons who exercise general or indirect supervision only.

**7. What is wastewater operating experience?**

Wastewater operating experience is time spent performing the hands-on operational duties of a wastewater treatment works operator, which includes direct hands-on physical operation of wastewater treatment equipment and/or wastewater treatment processes, direct active field supervision of wastewater treatment equipment and/or wastewater treatment processes, and/or direct and active involvement in process control decisions for wastewater treatment processes. At this time, wastewater operator experience may be acquired only in municipal wastewater treatment facilities.

**8. What does NOT count as hands-on wastewater operating experience?**

Public works, street maintenance, meter reading, operating a Vactor truck, sludge hauling/handling and/or application, janitorial, grounds keeping, collection systems and/or drinking water operations, laboratory testing, electrical and/or maintenance mechanic work.

**9. What is related experience?**

Related experience is experience operating collection systems or drinking water supplies or laboratory or maintenance experience at a wastewater treatment facility. Partial credit toward eligibility will be given once hands-on wastewater operating experience is obtained.

**10. What is a wastewater course?**

A wastewater course is defined as a course consisting of 3 quarter hours, or 2 semester hours, or 30 contact hours, or 3.0 continuing education units (CEUs) and must cover one or more aspects of wastewater treatment such as wastewater collection, treatment, operations, maintenance, or management from an accredited college, university, or technical vocational and trade school that is approved by the Agency. Training events that meet this definition will receive 3 months of credit toward the certification eligibility requirements. Training events which do not meet this definition will receive credit at the same rate as college/university courses.

The amount of credit that may be given for wastewater courses is dependent on the level of certification being sought. The maximum credit for wastewater courses per certification level is given below. Any wastewater courses which cannot be credited at the 3 month rate will be credited at the same rate as college university courses.

| <u>Certification Level</u> | <u>Maximum Credit for Wastewater Courses</u> |
|----------------------------|--|
| Class 1                    | 24 months (8 wastewater courses)             |
| Class 2                    | 24 months (8 wastewater courses)             |
| Class 3                    | 6 months (2 wastewater courses)              |
| Class 4                    | 3 months (1 wastewater courses)              |

**11. How is credit applied if my job duties consist of both wastewater operating experience and related experience?**

If your job duties consist of both wastewater operating experience and related experience, credit is assessed based on the percentage of time spent performing each type of duties. If 50% or more of time at work is classified as wastewater operating experience, full credit is given for wastewater operating experience and zero credit is given for related experience. If less than 50% of time at work is classified as wastewater operating experience, half credit is given for wastewater operating experience and half credit is given for related experience.

**12. How many hours per week must be worked to be considered full-time and/or parttime?**

30 hours or more per week is considered full-time employment and may be given full credit toward eligibility determination. Less than 30 hours per week is considered part-time employment and may be given partial credit toward eligibility determination. Less than 30 hours but greater than 10 hours per week may be given 50% credit toward eligibility determination. If the number of hours worked is 10 hours or less per week, then only 25% credit toward eligibility determination will be given.

**13. How often and where are wastewater examinations offered?**

Examinations are offered every month at three sites around the state. In the Greater Chicago metropolitan area an exam is offered every month in the Des Plaines Regional office. Other testing locations include the Springfield, Illinois EPA Headquarters and at ERTC in Edwardsville associated with SIU-E. At times, additional special exams may be offered at conferences. Please check the Illinois EPA website for the current examination calendar.

**14. How do I obtain wastewater certification?**

The necessary steps to become certified are:

- Submit a completed examination request form to the wastewater Operator Certification Unit. Examination request forms are available from the Operator Certification Unit or online at <https://www2.illinois.gov/epa/topics/water-quality/wastewater-operator-certification/Pages/schedule.aspx>. The examination request form is reviewed and the applicant is sent either an examination admittance letter or a letter indicating the eligibility shortfall.
- If a passing score of 70 or more is obtained on the examination, notification to the applicant that they are now designated as an Operator in Training will be made at the certification exam level they passed. This notification will also contain a request for a application to be made. On receipt of the application, the Agency will make a

determination if the applicant meets the eligibility requirements of the class level they passed. If eligibility requirements are met, then the applicant will be notified.

**15. To become certified at a particular level, must I work up to that level by passing the examinations for all of the lower certification levels?**

No, you may take any examination that you are eligible for. You do not have to pass the lower level examinations first.

**16. If I am eligible for two different Class levels (i.e., Class 2 and Class 1), can I take an exam for each Class level at the same time?**

No, you are allowed a maximum of three hours to complete the exam. Currently there are 100 questions per exam. To ensure there is adequate time to complete the exam without rushing through the questions, only one exam can be taken at a time.

**17. How many questions are on each exam?**

Currently the Collection Systems, the Class 4, Class 3, Class 2 and the Class 1 exam have 100 questions each. The industrial Class K (facility-specific) exam has a total of 15 questions, 5 multiple choice and 10 short answer/essay. The industrial Class R (general) exam has a total of 14 questions, 7 multiple choice and 7 short answer/essay.

**18. If I fail an examination, how long must I wait to retake it?**

There is no minimum period you must wait before you can retake an examination. You can take an examination the next time it is offered, once you have received your examination results notification letter.

**19. Can I schedule to take an examination for the same certification level on more than one examination date?**

No, you may only schedule for one examination date and location at a time. If you are scheduled for an examination, you may not schedule to take the same examination again until after you receive your examination results notification letter. The number of examinees that can be accommodated at each examination site is limited and if an individual schedules for more than one examination, it denies someone else the opportunity to take an examination.

If you are scheduled for an examination and after scheduling, find out you will not be able to attend as planned, you may contact the Operator Certification Unit to change your scheduled examination date.

**20. Can I just show up at an examination site and take an examination?**

No, you must first be determined eligible to take an examination. Eligibility is determined through the application process described above. In addition, each examination site will accommodate only a certain number of examinees and, even if you are eligible, there is no guarantee that there will be room for you. All scheduling for examinations will be done on a first-come first-served basis through the Operator Certification Unit. If you show up at an examination site and your name is not on the exam roster and you don't have an admittance letter, you will be turned away.

**21. Can I take a certification examination before I meet the eligibility requirements for that certification level?**

Yes, you may apply to take any level of certification under the guidelines of the Operator-In-Training program. You must submit an examination request form before taking the examination.

**22. What is the purpose of the Operator-In-Training certificates?**

The Operator-In-Training Basic certificate is intended to recognize individuals who feel they may pass the desired certification examination. The Operator-In-Training applicant may request to write on any desired certification level. If the applicant is able to pass the examination with a minimum score of 70, the applicant will be considered an Operator-In-Training at that certification level. Upon completing the remaining requirements, the applicant will then be granted certification at that level. The applicant's score will remain effective for a period of 5 years from date of examination. The applicant may only be recognized at the certification level the applicant requested. If the applicant decides to receive a different certification level, an examination at that level must be taken.

**Can an individual with an Operator-In-Training certificate be considered as the properly certified operator for a wastewater treatment facility?**

No, the properly certified operator for a particular wastewater treatment facility must be certified at a level equal to or higher than the certification level required for that facility. An Operator-In-Training certificate does not meet this requirement.

**23. Does the properly certified wastewater operator need to be present at the wastewater treatment facility all the time that it is in operation?**

The properly certified operator must exercise direct and active field supervision of the wastewater treatment facility. Situations will dictate whether or not the physical presence of the properly certified operator is required on site. However, in all situations, it is expected that the properly certified operator have sufficient knowledge of the treatment facility to handle any situation expeditiously and correctly.

**24. What is the difference between the general Class R and the facility-specific Class K certificates?**

The general Class R certificate, also referred to as a Class K-WR (Water Remediation), is intended only for treatment or pretreatment facilities which treat groundwater contaminated with gasoline, diesel fuel, jet fuel, fuel oil, and/or kerosene. Most of these facilities are associated with entities which store petroleum fuels underground, such as gas stations. The main treatment process involved is either air stripping or activated carbon canister. Facilities treating groundwater contaminated with other substances, such as solvents, require facility-specific Class K certification. An operator who holds Class R certification may operate any treatment or pretreatment facility in Illinois which treats groundwater contaminated with gasoline, diesel fuel, jet fuel, fuel oil, and/or kerosene.

A facility-specific Class K certificate, as the name implies, is issued for the operation of the specific industrial wastewater treatment or pretreatment facility for which the operator wrote the examination. An operator, with a facility-specific Class K certificate, who leaves the facility in which he is certified, to operate another industrial wastewater treatment or pretreatment facility, must apply for and pass the Class K examination for the second industrial wastewater treatment or pretreatment facility in order to be properly certified for the second facility. In addition, an operator who holds a facility-specific Class K industrial wastewater treatment or pretreatment facility which is upgraded to include additional and/or different treatment processes than the original facility must apply for and pass the Class K examination for the upgraded industrial wastewater treatment or pretreatment facility in order to be properly certified for the upgraded facility.

**25. If I hold a municipal certification, such as a Class 1, can I operate an industrial facility without taking a Class K exam?**

No, municipal and industrial wastewater treatment works have different operating requirements which are spelled out in the operating and discharge permits held by the facilities. Industrial facilities require a facility-specific Class K operator certified for operations at that specific facility. (See Item #24 above.)

**26. Do I need to notify the Agency if I change my name or home address, or if I begin or terminate employment with a wastewater treatment works facility?**

Yes, whenever a certified operator begins or terminates employment with a wastewater treatment works or pretreatment works, the employee/operator and the owner of the facility must notify the Agency of any changes in writing within 7 days. An operator must notify the Agency within 30 days of any change in name and/or home address.

The [Change in Personnel Notification Form](#) should be used to notify the Agency of these changes.

**27. How long is a wastewater certificate in effect? Do wastewater certificates have to be renewed?**

Beginning on July 1, 2020, Class 1 and Class 2 certifications will be issued with the expiration date being three years from July 1 of the calendar year in which the certificate was issued. Class 1 and Class 2 certifications issued before July 1, 2020 will expire on July 1, 2023.

Beginning on July 1, 2019 Class 3 and Class 4 certifications will be issued with the expiration date being three years from July 1 of the calendar year in which the certificated was issued. Class 3 and Class 4 certifications issued before July 1, 2019 will expire on July 22, 2022.

If the operator fails to do so, the operator must retake the certification examination for the desired level of certification.

**28. Are there any fees associated with wastewater operator certification?**

There are no fees associated with wastewater operator certification at the present time. However, this does not preclude the institution of wastewater certification fees at some point in the future.

**29. Is there any continuing education requirement associated with wastewater operator certification?**

Yes. There are continuing education requirement associated with wastewater operator certification. Class 1 and 2 operators must complete 30 hours (20 technical/10 nontechnical) every 3 years. Class 3 and 4 operators must complete 15 hours (10 technical/5 non-technical) every 3 years. Collection system certificates, Class K and Class R, do not require any CEU hours.

Technical training may include but not limited to:

|                   |                    |                           |
|-------------------|--------------------|---------------------------|
| Activated sludge  | Aeration           | Backwash filters          |
| Chem addition     | Chlorinators       | Clarifiers                |
| Collection Sys.   | Digesters          | DMRs                      |
| Disinfection      | Electrical Maint   | Fixed Film                |
| Imhoff tanks      | Instrumentation    | Intermittent sand filters |
| Lab procedures    | Lagoons            | Math                      |
| Maintenance       | Operations         | Oxidation ditches         |
| Package aeration  | Preliminary        | Primary treatment         |
| Reports/Records   | SCADA              | Screening                 |
| Sedimentation     | Sludge drying beds | Sludge handling           |
| Land applications | Sludge presses     | Tertiary treatment        |

NON-technical training may include but not limited to:

|                 |                              |                    |
|-----------------|------------------------------|--------------------|
| Administration  | Computers                    | Emergency planning |
| Management      | First-aid                    | Safety             |
| Confined spaces | Weather (wastewater related) |                    |

All training must be approved by the Agency. Training providers or certified operators may request approval of training by the Agency. Training providers must show proof of training documentation to the trainees in order for the training to be accepted for certificate approval.

The operators are required to maintain copies of the proof of training records for a time period of 6 years from the date of training. The Agency may audit proof of training by random selection or when additional information is necessary.

Proof of training records must include:

|             |                   |                       |
|-------------|-------------------|-----------------------|
| Course name | Training provider | Instructor/speaker    |
| Location    | Dates             | Total hours completed |

Attendance verifications records (diploma, certificate, Grade reports, etc. with the course number referenced)

**30. Does Illinois have reciprocity with wastewater certifying authorities from any other states?**

Yes, depending on the reciprocal state. The certifying state's rules and regulations, in conjunction with an individual's education and employment qualifications, are used to determine the specific Illinois certificate that can be issued. However, according to Illinois regulations, if another state does not accept Illinois' program for reciprocity, then Illinois cannot accept that state for reciprocity. It should be noted that, due to the uniqueness of Illinois' industrial certification program, it is not possible to consider issuing Class K certificates by reciprocity. Collection system certification is also not considered through reciprocity as it is a voluntary certification.

**31. Can the Agency 'discipline' wastewater operators?**

Yes, the Agency can 'discipline' wastewater operators through the certificate sanction process. Potential causes for sanctions include, but are not limited to, the following:

- Obtaining or attempting to obtain certification by fraud or deceit.
- Gross negligence or gross misconduct in the operation of a wastewater treatment facility or pretreatment facility.
- Falsification of records and reports that are required by the Environmental Protection Act or any rules promulgated under it.
- Willful failure to maintain records and reports that are required by the Environmental Protection Act or any rules promulgated under it.

- Willful non-submission of records and reports that are required by the Environmental Protection Act or any rules promulgated under it.
- Willful violation of the Environmental Protection Act or any rules that are promulgated under it.
- A final judgment in a civil action or a conviction in a criminal action that an operator has performed any of the acts listed above.

Sanctions include, but are not limited to, prohibiting application for certification, probation, suspension, and revocation.

### **32. What does it mean if my wastewater certificate is suspended?**

A suspended wastewater certificate is considered invalid during the suspension period. A certificate may be suspended for a period of up to 18 months. Experience obtained during the suspension period will not be considered for credit toward meeting certification eligibility requirements. At the end of the suspension period, the certificate is again considered valid. Experience obtained after the suspension is lifted will be considered for credit toward meeting certification eligibility requirements.

### **33. What does it mean if my wastewater certificate is revoked?**

A revoked certificate is considered invalid. The operator may not reapply for any certificate for a period of not less than 18 months and not more than 4 years. Experience obtained during the revocation is not considered for credit toward meeting certification eligibility requirements. At the end of the revocation period, an operator must apply for and pass the certification examination for the desired level of certification to become certified as a wastewater operator again.

## **Municipal Operator Certification Program**

All publicly owned wastewater treatment facilities and municipal wastewater treatment works not owned by an industry are classified in one of four groups. These groups are:

- Group 1 all wastewater treatment facilities 1.0 MGD or more design average flow (DAF) excluding lagoon systems and primary treatment systems
- Group 2 activated sludge systems with a DAF of less than 1.0 MGD
- Group 3 fixed film processes, stationary and rotating trickling filters, Rotating Biological Contactors, Imhoff tank systems, and sand filters with a DAF of less than 1.0 MGD and all primary treatment systems
- Group 4 all aerated and non-aerated lagoon treatment systems

The certified wastewater operator requirements for each group of wastewater treatment facilities are as follows:

- Group 1 wastewater treatment facilities require a certified Class 1 wastewater operator
- Group 2 wastewater treatment facilities require a certified Class 2 or Class 1 wastewater operator
- Group 3 wastewater treatment facilities require a certified Class 3, Class 2, or Class 1 wastewater operator
- Group 4 wastewater treatment facilities require a certified Class 4, Class 3, Class 2, or Class 1 wastewater operator

The eligibility requirements for the Class 1, Class 2, Class 3, and Class 4 wastewater certification examinations are given below. Operator-In-Training status will be granted for successful passing of certification exam (valid for 5 years)

**Class 1** - Requires a total of 6 years' experience

Minimum eligibility requirement - High school completion or GED certificate plus 3 years' wastewater operator experience and the equivalent of 3 years substitutional experience

**Class 2** – Requires a total of 4 years' experience

Minimum eligibility requirement - High school completion or GED certificate plus 2 years' wastewater operator experience and the equivalent of 2 years' substitutional experience

**Class 3** - Requires a total of 2 years' experience

Minimum eligibility requirement - High school completion or GED certificate plus 1 year wastewater operator experience and the equivalent of 1 year substitutional experience

**Class 4** - Requires a total of 1 year experience

Minimum eligibility requirement - 6 months' wastewater operator experience and the equivalent of 6 months substitutional experience

Wastewater operator experience includes direct hands-on physical operation of wastewater treatment equipment and/or wastewater treatment processes, direct active field supervision of wastewater treatment equipment and/or wastewater treatment processes, and/or direct and active involvement in process control decisions for wastewater treatment processes. Wastewater operator experience may be acquired at a domestic/municipal wastewater treatment facilities.

Substitutional experience includes credit for completion of wastewater courses, credit for completed college work (applicable to Classes 3, 2 and 1 only), credit for completion of college programs one-year in length designed specifically for wastewater treatment works operation, credit for experience operating collection systems or drinking water supplies. The only time college credit can be applied toward Class 4 eligibility is upon the successful completion of a one-year college program specifically designed for wastewater treatment works operation, which includes actual operation of a wastewater treatment works, and may be substituted for a maximum of one year wastewater operator experience, such as with the program offered through ERTC at Southern Illinois University at Edwardsville. Partial credit for laboratory and/or maintenance experience at a wastewater treatment works may be granted only after hands-on wastewater operating experience has been obtained.

## **Industrial (Class K) Operator Certification Program**

Currently, there are two types of Class K (Industrial) certificates offered. The first type is facility-specific and covers a particular industrial wastewater treatment facility or pretreatment facility. Individuals who pass a facility-specific Class K examination are issued a certificate that is only valid for the specific industrial wastewater treatment facility or pretreatment facility for which the examination was taken. Individuals seeking wastewater operator certification for multiple industrial wastewater treatment facilities or pretreatment facilities requiring facility-specific Class K certification must complete and pass the facility-specific Class K examination for each treatment facility.

Persons seeking certification for a surface water or groundwater remediation treatment system for contamination resulting from gasoline, diesel fuel, kerosene, jet fuel, or heating oil may opt to take another type of Class K examination, the Class R (Water Remediation). A general Class R examination is available which covers treatment systems associated with these water remediation systems. Individuals who pass this general exam are issued a Class R general certificate that is valid for all water remediation systems for contamination resulting from gasoline, diesel fuel, kerosene, jet fuel, or heating oil.

Any individual who actively operates an industrial wastewater treatment facility or pretreatment facility or who actively supervises the operation of an industrial wastewater treatment facility or pretreatment facility is eligible for Class K wastewater operator certification. Currently, there are no minimum education or experience eligibility requirements for Class K wastewater operator certification. A completed Class K certification application must be submitted for each industrial wastewater treatment facility or pretreatment facility for which Class K wastewater operator certification is sought.

The Class K certification expires after 5 years. The applicant must renew by requesting and successfully passing the Class K examination. There are no CEU requirements for the Class K certificate.

## **Collection System Operator Certification Program**

This is a voluntary program available to individuals directly involved in the operation and maintenance of collection systems/sewers who choose to participate in a certification program.

There is one level of collection system operator certification.

The minimum eligibility requirements for this certificate are:

12 months' experience total which must be made up of high school completion or GED certificate, plus a minimum of 3 months collection system operating experience, and the equivalent of 6 months substitutional experience. Up to 6 months substitutional credit may be granted for completion of collection system and/or wastewater courses, and/or for wastewater operating experience or any combination of substitute credits, not to exceed 6 months.

The Collection System Operator Certificate has no expiration and is not subject to CEU requirements at this time.

# **Certification Examinations**

## **Municipal, Operator-In-Training, & Collection System Examinations**

The questions used on wastewater and collection system examinations were developed by wastewater professionals, instructors, certified operators, etc. Each question has been validated by a panel comprised of experts who, collectively, have many years of experience in the wastewater and/or collection system operations field. Every question, with each of the four answer selections, has been examined for content, readability, accuracy, and relation to the corresponding Task Analysis. The validation process is on-going and new questions are validated as they are developed. Validated questions, which through use and statistical evidence are shown to be unreliable (i.e., they do not test what they are supposed to test), are returned to the review panel for restructuring or removal from the question bank. Finally, all questions in the question bank are periodically reviewed by the review panel to make sure they are still current and valid for wastewater operators.

Each exam question is related to one of the following subject categories:

|                           |                                       |
|---------------------------|---------------------------------------|
| Activated Sludge          | Mathematics                           |
| Chemical Addition         | Motors                                |
| Collection Systems        | Preliminary Treatment                 |
| Digesters                 | Primary Treatment                     |
| Disinfection              | Pumps and Pumping                     |
| Electrical                | Rotating Biological Contactors (RBCs) |
| Flow Measurement          | Recordkeeping                         |
| General Information       | Rules and Regulations                 |
| Imhoff Tanks              | Safety and Health                     |
| Intermittent Sand Filters | Secondary Sedimentation               |
| Laboratory                | Sludge Drying Beds                    |
| Lagoons                   | Sludge Handling                       |
| Maintenance               | Tertiary Treatment                    |
| Management                | Trickling Filters                     |

Each examination version has 100 multiple choice questions taken from the categories which are applicable for the certification level being tested on that particular examination. Although slight variations in subject categories and numbers of questions per subject category may exist between versions of examinations for the same certificate level, every effort is made to maintain consistency and equality between different examination versions for the same certificate level.

The table below indicates the subject categories generally associated with each of the four municipal/domestic certification examinations. These numbers are subject to change.

| <b><u>Category</u></b>                | <b><u>Class 4</u></b> | <b><u>Class 3</u></b> | <b><u>Class 2</u></b> | <b><u>Class 1</u></b> |
|---------------------------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| Activated Sludge                      | 4                     | 10                    | 15                    | 18                    |
| Chemical Addition                     | 0                     | 1                     | 3                     | 2                     |
| Collection Systems                    | 5                     | 5                     | 3                     | 3                     |
| Digesters                             | 3                     | 5                     | 8                     | 8                     |
| Disinfection                          | 7                     | 3                     | 5                     | 5                     |
| Electrical                            | 2                     | 2                     | 3                     | 2                     |
| Flow Measurement                      | 2                     | 2                     | 4                     | 2                     |
| General Information                   | 12                    | 6                     | 3                     | 3                     |
| Imhoff Tanks                          | 1                     | 2                     | 1                     | 1                     |
| Intermittent Sand Filters             | 3                     | 0                     | 0                     | 0                     |
| Laboratory                            | 5                     | 5                     | 5                     | 5                     |
| Lagoons                               | 15                    | 5                     | 3                     | 2                     |
| Maintenance                           | 4                     | 3                     | 1                     | 1                     |
| Management                            | 2                     | 2                     | 3                     | 5                     |
| Mathematics                           | 10                    | 10                    | 10                    | 10                    |
| Motors                                | 2                     | 2                     | 2                     | 2                     |
| Preliminary Treatment                 | 2                     | 2                     | 2                     | 2                     |
| Primary Treatment                     | 2                     | 4                     | 2                     | 2                     |
| Pumps and Pumping                     | 2                     | 4                     | 4                     | 4                     |
| RBCs (rotating biological contactors) | 1                     | 1                     | 1                     | 1                     |
| Recordkeeping                         | 2                     | 2                     | 2                     | 3                     |
| Rule and Regulations                  | 1                     | 2                     | 2                     | 2                     |
| Safety and Health                     | 5                     | 5                     | 5                     | 5                     |
| Secondary Clarifiers                  | 1                     | 1                     | 2                     | 2                     |
| Sludge Drying Beds                    | 2                     | 2                     | 2                     | 2                     |

|                    |   |    |   |   |
|--------------------|---|----|---|---|
| Sludge Handling    | 2 | 2  | 4 | 4 |
| Tertiary Treatment | 0 | 0  | 2 | 2 |
| Trickling Filters  | 5 | 13 | 3 | 2 |

Each examination will be increase successively in difficulty from the class 4 exam to the class 1 exam. The class 4 will emphasize lagoons and lagoon related math. The class 3 will emphasize fixed film and intermediate math. The class 2 will emphasize activated sludge and activated sludge math. The class 1 will emphasize activated sludge (advanced) and complex math.

The subject categories generally associated with the Collection System examination are:

Chemical Addition, Collection Systems, Flow Measurement, General Information, Maintenance, Management, Mathematics, Motors, Preliminary Treatment, Pumps and Pumping, Recordkeeping, Rules and Regulations, Safety

Individuals taking these examinations are given scratch paper, pencils, answer sheet, and one examination booklet containing questions, formulas and conversion factors. The only items that may be brought to the examination site are the examinee's examination admittance letter, a photo ID, and a calculator which must be non-programmable and incapable of storing alphanumeric data. Other electronic devices (cell phones, Apple watches, iPods, mp3 players, blackberries, etc.) will not be allowed during the entire time an individual is in the examination room. A maximum of three hours is allowed to complete the examination. A copy of the conversion factors and formulas provided with each examination is included at the end of this study guide. Familiarization with the format should cut down on referencing time during the examination.

Examination results are sent to an examinee's home address, usually within 2 weeks of the day the examination is taken. Each examinee receives a letter indicating whether he/she passed the examination accompanied by a detailed breakdown of performance on the examination. Examinees who fail to achieve a score of 70% on an examination can use these results to determine the areas to focus on for further study.

Examinees that score less than 70% on an examination may reschedule for the same level of examination without submitting another application, by returning the examination rescheduling form provided with their examination results or by calling the wastewater operator certification staff.

### **Industrial (Class K) Examinations**

The examinations consist of multiple choice questions covering basic wastewater mathematics and short answer/essay questions designed to test an individual's knowledge of the wastewater facility for which certification is sought. Examinees should be capable of providing, without

the use of supplemental aids, information pertaining to an industrial wastewater treatment works in the following areas:

- Flow schematics;
- Purpose of each treatment unit;
- Theory of operation (principles of treatment) for each treatment unit;
- Measures used to prevent and correct process upsets;
- Methods used for solids handling;
- Sludge disposal techniques;
- Sources, characteristics, and concentrations of the wastes treated;
- Removal efficiencies for each treatment unit;
- Effluent monitoring requirements;
- Laboratory techniques and interpretation of laboratory results;
- Safety considerations;
- Rules and regulations which apply;
- Record keeping

Individuals taking a Class K examination are given scratch paper, pencils, and one examination booklet containing questions, formulas and conversion factors. The only items that may be brought to the examination site are the examinee's examination admittance letter, a photo ID, and a calculator which must be non-programmable and incapable of storing alpha-numeric data. Other electronic devices (cell phones, Apple watches, iPods, mp3 players, blackberries, etc.) must be turned off the entire time an individual is in the examination room. A maximum of three hours is allowed to complete the examination. A copy of the conversion factors and formulas provided with each examination is included at the end of this study guide. Familiarization with the format should cut down on your referencing time during the examination.

Examination results are sent to an examinee's home address, usually within 4 weeks of the day the examination is taken. Each examinee receives a letter indicating whether he/she passed the examination.

Examinees that score less than 70% on an examination may reschedule for the same level of examination by completing a Examination Request Form and returning it to the Agency.

## **Wastewater Certification Examination Scheduling**

Every month approximately 50+ individuals are scheduled to take the wastewater operator certification examinations. Most of the facilities used to administer wastewater operator certification examinations are conference rooms located in State Regional Office buildings. The number of individuals that can be scheduled for a wastewater certification examination at a specific location is limited by the physical size of the room used. Thus, there is a maximum number of individuals that we can schedule for a given examination site.

If an application is received early enough, in most instances we are able to schedule an individual for the examination site and examination date requested. At times, if the situation warrants, an additional examination session at a specific location may be scheduled. Individuals who attempt to schedule for a second examination date and location when they are already scheduled for a different examination date and location, or individuals who have taken an examination and do not wait to receive their examination results before scheduling to retake an examination, aggravate the scheduling situation. In order to give everyone an equal opportunity to take a wastewater certification examination, we offer the following guidelines for wastewater examination scheduling:

1. Indicate a first and second choice for examination date and/or examination location when submitting a wastewater certification application or scheduling to retake an examination. In almost all cases, an individual will be scheduled for one of his/her two choices.
2. Wait until examination results are received before scheduling to retake an examination. If you think you did that poorly, your time would be best spent seeking additional wastewater treatment knowledge until your actual score is received.
3. If you know ahead of time that you cannot make it to an examination for which you are scheduled, contact the Operator Certification Unit as soon as possible to cancel so another individual can possibly be scheduled in your place. Your name will be removed from the list of the examination for which you cancelled and taken off the exam roster. Should you show up for that examination anyway, you will be turned away.

## **Contract Operation**

Owners of wastewater treatment works, rather than employing a properly certified wastewater operator, may choose to meet the certified wastewater operator requirement by contracting either with an individual wastewater operator with the required wastewater certificate or with a contract operations firm. In either case, a copy of the signed contract is required to be submitted to the Agency for review. The section of the wastewater operator certification rules pertaining to contract operation is included below.

### **Section 380.1000 General**

- a) The owner of a wastewater treatment works or pretreatment works who enters into a contractual agreement with a properly certified operator for the operation of a wastewater treatment works or pretreatment works shall submit a copy of the contractual agreement to the Agency.
- b) The contractual agreement must be submitted to the Agency within seven days of the effective date of the contractual agreement. The Agency must be notified by the owner in writing within seven days should the contract be terminated prior to the expiration date of the contract.

### **Section 380.1005 Contract Provisions**

The contract must include the following:

- a) The parties involved, including names, addresses and phone numbers of each contract operator's ID #;
- b) The specific starting and expiration dates of the contract;
- c) The minimum number of visits to be made to the wastewater treatment works by the contract operator each week;
- d) The duties and responsibilities of each party involved including, at a minimum, the party responsible for:
  - 1) Proper operation of the wastewater treatment works including meeting all NPDES permit effluent requirements;
  - 2) Sample collection pursuant to the NPDES Permit;
  - 3) Preparation and submittal of Discharge Monitoring Reports;
  - 4) Laboratory analysis;
  - 5) Maintaining lift stations;
  - 6) Maintaining spare parts inventory;
  - 7) Maintaining required operating records and reports;
  - 8) Providing labor and materials for correcting any maintenance and operational problems;
  - 9) Maintaining, and if necessary, implementing an emergency operating plan;
  - 10) Performing preventive maintenance on equipment as recommended by the manufacturer; and
  - 11) Performing routine operational control testing as recommended by the Agency.
- e) The signature of each party of the contract.

### **Section 380.1010 Non-party Operators**

- a) When the properly certified operator is not a party to the contract, the operator must sign a document indicating acceptance of responsibilities of the certified operator as specified in the contract.
- b) In the event that a different properly certified operator is assigned to operate the wastewater treatment works, which is the subject of the contract, the new operator shall sign and submit a document as required in Subsection (a) above.

### **Section 380.1015 Documentation of Contract Provisions**

The contract operator shall maintain records to document that all contract provisions are being met.

### **Section 380.1020 Contract Approval**

The Agency will approve a contract agreement when the contractual operator is properly certified and the provisions of Sections 380.1000, 380.1005 and 380.1010 are satisfied. The Agency will withdraw an approval when it is determined that the contract provisions are not being met or are inadequate to assure proper operation of the wastewater treatment works.

### **Section 380.1025 Contract Modifications and Extensions**

Modifications or extensions to contractual agreements must be submitted to the Agency as a new contract.

## **Training Opportunities**

Whether you are just starting in the wastewater treatment field or have been in the field for many years, there is training and resources available to meet most any need. In addition to the many training materials that are available (see Suggested Study/Reference Materials on page 28 below for the most widely used/recognized), various community colleges throughout the state offer classroom courses on wastewater treatment. In areas where no formal classroom wastewater training is available, individuals may opt to take one or more of the home study courses that are available. Individuals seeking hands-on training along with classroom instruction should check out the 1-year water and wastewater training program through the Environmental Resources Training Center (ERTC) located on the campus of Southern Illinois University at Edwardsville. In addition, local, state, and national operator groups offer timely technical sessions at their meetings/conferences on various aspects of wastewater treatment. Some equipment manufacturers also provide training on various topics, usually pertaining to the equipment that they handle.

## **Operator Organizations**

Wastewater operator groups function at the local, state, and national levels. In addition to the information presented via the technical sessions at their meetings/conference, these groups provide a framework for networking amongst individual operators. A listing of wastewater operator groups is given below. (Current as of August 2017)

### **Local Groups**

Central Illinois Professional Wastewater Operators (CIPWO)

[www.orgsites.com/il/cipwo](http://www.orgsites.com/il/cipwo)

Fox Valley Operators Association

[www.fvoa-illinois.org](http://www.fvoa-illinois.org)

Heart of Illinois Water Pollution Control Operators

Kish-Rock Water Pollution Control Operators

Mid-Central Water Pollution Control Operators

Mississippi – Kaskaskia Valley Water Pollution Control Operators (MISKA)

[www.mis-ka.com](http://www.mis-ka.com)

Miss-Rock Water Pollution Control Operators

North Central Water & Wastewater Operators Association

Southern Illinois Wastewater Operators (SIWO)

### **Statewide Groups**

Illinois Association of Water Pollution Control Operators (IAWPCO)

[www.iawpco.org](http://www.iawpco.org)

Illinois Water Environment Association (IWEA)

[www.iweasite.org](http://www.iweasite.org)

Illinois Rural Water Association (IRWA)

[www.ilrwa.org](http://www.ilrwa.org)

## **Regional Groups**

Central States Water Environment Association  
[www.cswea.org](http://www.cswea.org)

## **National Groups**

Water Environment Federation (WEF)  
[www.wef.org](http://www.wef.org)

# **SOURCES OF WASTEWATER STUDY/REFERENCE MATERIALS**

## **SOURCE ADDRESSES**

Southern Illinois University, Edwardsville  
Environmental Resources Training Center  
Campus Box 1075  
Edwardsville, IL 62026-1075  
(618) 650-2030  
[www.siu.edu/ertc/](http://www.siu.edu/ertc/)  
email: [siue-ertc@siue.edu](mailto:siue-ertc@siue.edu)

Department of Civil Engineering  
California State University, Sacramento  
6000 J Street  
Sacramento, CA 95819  
(916) 278-6142  
[www.owp.csus.edu](http://www.owp.csus.edu)  
email: [wateroffice@owp.csus.edu](mailto:wateroffice@owp.csus.edu)

Illinois Environmental Protection Agency  
DWPC/Permit Section/Watershed Unit  
#15  
P.O. Box 19276  
Springfield, IL 62794-9276  
(217) 782-1696

Illinois Environmental Protection Agency  
BOW/Compliance Assurance Section #19  
P.O. Box 19276  
Springfield, IL 62794-9276  
(217) 782-9720  
[www2.illinois.gov/epa/topics/water-quality/wastewater-operator-certification](http://www2.illinois.gov/epa/topics/water-quality/wastewater-operator-certification)  
email: [Debbie.Alderman@illinois.gov](mailto:Debbie.Alderman@illinois.gov)

CRC Press, Inc./Lewis Publishers 2000  
Corporate Blvd., N.W.  
Boca Raton, FL 33431  
(800) 272-7737

National Technical Information Service  
5285 Port Royal Road  
Springfield, VA 22161

ORD Publications  
P.O. Box 19962  
Cincinnati, OH 45219  
(513) 569-7562

Technomic Publishing Co., Inc.  
851 New Holland Avenue, Box 3535  
Lancaster, PA 17604  
800/233-9936 or 717/291-5609

Texas Water Utilities Association  
1106 Clayton Lane, Suite 101-E  
Austin, TX 78723-1033

Water Environment Federation  
Publications Order Department  
601 Wythe Street  
Alexandria, VA 22314-1994  
(800) 666-0206  
[www.wef.org/onlineeducation/](http://www.wef.org/onlineeducation/)  
email: [pubs@wef.org](mailto:pubs@wef.org)

Association of Boards of Certification  
2805 SW Snyder Blvd., Suite 535 Ankeny,  
IA 50023 (515) 232-3623  
[www.abccert.org](http://www.abccert.org)  
[www.abccert.org/testing\\_services/default.asp](http://www.abccert.org/testing_services/default.asp)

## **Suggested Study/Reference Materials**

### **CALIFORNIA STATE UNIVERSITY AT SACRAMENTO:**

Operation of Wastewater Treatment Plants, a Field Study Training Program

- a. Volume I
- b. Volume II

Operation and Maintenance of Wastewater Collection Systems, a Field Study Training Program

- a. Volume I
- b. Volume II

Advanced Waste Treatment, a Field Study Training Program

Membrane Bioreactors (MBRs) – 2012 - ISBN 978-1-59371-064-4

### **ENVIRONMENTAL RESOURCES TRAINING CENTER (ERTC):**

Math Review for Wastewater Certification

Stabilization Pond Filtration

Guide to Microscopic Evaluation for Sewage Treatment Operations

### **ILLINOIS ENVIRONMENTAL PROTECTION AGENCY (IEPA):**

35 Ill. Adm. Code, Subtitle C: Water Pollution

Design Criteria for Sludge Application on Land (35 Ill. Adm. Code 391)  
(Request from Permits Section)

Procedures for the Certification of Operators of Wastewater Treatment Works  
(35 Ill. Adm. Code 380) (Request from Compliance Assurance Section)

### **ORD PUBLICATIONS &/or NATIONAL TECHNICAL INFORMATION SERVICE (NTIS):**

1. Stabilization Ponds Operations Manual, (USEPA 430/9-77-012)
2. Aerobic Biological Wastewater Treatment Facilities, (USEPA 430/9-77-006, N/055-00101071-1)
3. Anaerobic Sludge Digestion, (USEPA 430/9-76-001)

**WATER ENVIRONMENT FEDERATION (WEF):**

(NOTE: WEF's Technical Publications Catalog includes many items in addition to those listed below.)

MOP 1 Safety and Health in Wastewater Systems

MOP 11 Operation of Wastewater Treatment Plants

Standard Methods for the Examination of Water and Wastewater - Latest Edition

Math Workbook for Collection System Operators

Wastewater Treatment Operator Grades I & II Exam Survival Guide

WEF/ABC Certification Study Guide for Wastewater Treatment Personnel

WEF/ABC Certification Study Guide for Collection Systems Personnel

MOP OM-10 Operation and Maintenance of Trickling Filters, RBC's, and Related Processes

MOP 16 Anaerobic Sludge Digestion

MOP OM-8 Operation and Maintenance of Sludge Dewatering Systems

Basic Maintenance of Circular Secondary Clarifiers - PROBE

Basic Maintenance of Rectangular Secondary Clarifiers - PROBE

MOP 5 Aeration in Wastewater Treatment

MOP OM-7 Operation of Extended Aeration Package Plants

Basic Activated Sludge Process Control - PROBE

Basic Maintenance of Diffused Aeration Systems - PROBE

Basic Maintenance of Mechanical Aeration Systems - PROBE

Wastewater Biology: The Microlife

Wastewater Biology: The Life Processes

Activated Sludge Microbiology

MOP OM-9 Activated Sludge

MOP 2 Preliminary Treatment for Wastewater Facilities

MOP FD-1 Sludge Thickening

MOP FD-9 Wastewater Residuals Stabilization

MOP FD-14 Sludge Conditioning

Wastewater Treatment Fundamentals I – Liquid Treatment

Wastewater Treatment Fundamentals II – Solids Handling and Support Systems

**TECHNOMIC PUBLISHING CO., INC.**

Applied Math for Wastewater Plant Operators

**CRC PRESS, INC./LEWIS PUBLISHERS**

Management & Supervision for Working Professionals

**TEXAS WATER UTILITIES ASSOCIATION:**

Manual of Wastewater Treatment

**Resources Pertaining to Treatment Facility Security**

1. [Water Security Home \(USEPA\)](#)
2. [Management and Planning for Small Community Wastewater](#): Protecting Your Community's Assets: A Guide For Small Wastewater Systems (NETCSC)
3. [Vulnerability Self-Assessment Tool \(VSAT\) and the Association of Metropolitan Sewerage Agencies \(AMSA\)](#)
4. [Emergency Preparedness USA \(FEMA\)](#)
5. Guarding Against Terrorist & Security Threats: Suggested Measures for Drinking Water & Wastewater Utilities, Appendix B of Emergency Response Plan Guidance for Small & Medium Community Water Systems to Comply with the Public Health Security & Bioterrorism Preparedness & Response Act of 2002 (USEPA)  
[http://www.epa.gov/safewater/watersecurity/pubs/small\\_medium\\_ERP\\_guidance040704.pdf](http://www.epa.gov/safewater/watersecurity/pubs/small_medium_ERP_guidance040704.pdf)
6. Guidance for Water Utility Response, Recovery, & Remediation Actions for Manmade &/or Technological Emergencies  
<http://www.epa.gov/safewater/watersecurity/pubs/er-guidance.pdf>

## **Wastewater Operator Certification Contact Information**

Illinois Environmental Protection Agency

Bureau of Water/ CAS #19

P.O. Box 19276

1021 N. Grand Ave. East

Springfield, IL 62794-9276

Telephone: 217-782-9720

Fax: 217-782-0075

Email: [Debbie.Alderman@illinois.gov](mailto:Debbie.Alderman@illinois.gov)

# WASTEWATER MATH FORMULA SHEET

## CONVERSION FACTORS

|                              |                              |                       |                   |
|------------------------------|------------------------------|-----------------------|-------------------|
| 12 in = 1 ft                 | 27 cu ft = 1 cu yd           | 1,000 mg = 1 gm       | 60 sec = 1 min    |
| 3 ft = 1 yd                  | 7.5 gal = 1 cu ft            | 1,000 gm = 1 kg       | 60 min = 1 hour   |
| 5,280 ft = 1 mi              | 8.34 lbs = 1 gal water       | 1,000 ml = 1 liter    | 1,440 min = 1 day |
| 144 sq in = 1 sq ft          | 62.4 lbs = 1 cu ft water     | 2.31 ft water = 1 psi | 10,000 mg/L = 1%  |
| 43,560 sq ft = 1 acre        | 746 watts = 1hp              | 454 gm = 1 lb         |                   |
| Population Equivalent (PE) = | 0.17 pounds BOD/capita/day   |                       |                   |
| =                            | 0.20 pounds SS/capita/day    |                       |                   |
| =                            | 100 gallons water/capita/day |                       |                   |

## ABBREVIATIONS

|               |           |            |              |              |
|---------------|-----------|------------|--------------|--------------|
| L = Length    | W = Width | H = Height | r = Radius   | d = Diameter |
| Q = Flow Rate | A = Area  | V = Volume | v = Velocity |              |

## AREA

|                             |  |  |
|-----------------------------|--|--|
| Rectangle: $A = L \times W$ | Triangle: $A = \frac{1}{2} (B \times H)$ | Circle: $A = \pi r^2$<br>$A = .785d^2$ |
|-----------------------------|--|--|

## VOLUME

|                           |                              |  |
|---------------------------|------------------------------|--|
| Cylinder: $V = \pi r^2 H$ | Basin: $L \times W \times H$ | Cone: $V = \frac{1}{3} (\pi r^2 H)$<br>$V = \frac{1}{3} (.785d^2 H)$ |
| $V = .785d^2 H$           |                              |  |

## VELOCITY

Velocity:  $\frac{\text{distance}}{\text{time}}$

## DETENTION TIME

Detention Time:  $\frac{\text{Volume}}{Q \text{ (flow)}}$

## POUNDS FORMULA

**concentration x flow or volume x constant**

$\frac{\text{mg}}{\text{L}}$  (or ppm) x MG (or MGD) x 8.34 (pounds per gallon of water)

## SEDIMENTATION AND LOADING RATE

$$\text{Weir Overflow Rate: } \frac{\text{total flow}}{\text{length of weir}} \qquad \text{Surface Settling Rate: } \frac{\text{flow rate}}{\text{surface area}}$$

$$\text{Solids Loading Rate: } \frac{\text{lbs solids applied}}{\text{area}} \text{ surface}$$

$$\text{Percent Efficiency or Percent Removal: } \frac{(\text{in} - \text{out})}{(\text{in})} \times 100 \%$$

$$\text{Organic Loading Rate (Lagoon): } \frac{\text{lbs BOD per day}}{\text{acres of lagoon}}$$

$$\text{Organic Loading Rate (Trickling Filter): } \frac{\text{lbs BOD per day}}{1000 \text{ cu ft of filter}}$$

## ACTIVATED SLUDGE

$$\text{SVI: } \frac{30 \text{ min settling volume (ml/L)}}{\text{MLSS (mg/L)}} \times 1,000 \text{ mg}$$

$$\text{Solids Inventory, lbs: (Tank volume, MG) x (solids concentration, mg/L) x (8.34 lbs / gal)}$$

$$\text{Gould's Sludge Age, days: } \frac{\text{Solids Under Aeration (MLSS), lbs}}{\text{Solids Added (influent TSS), lbs/day}}$$

$$\text{F/M: } \frac{\text{BOD Applied}}{\text{Organic Solids Under Aeration}}$$

$$\text{MCRT: } \frac{\text{Solids Inventory (lbs in aeration) + (lbs in clarifier)}}{\text{Solids Wasted (lbs WAS) + Effluent Solids (lbs TSS)}}$$

## SLUDGE DIGESTION

$$\text{Dry Solids, lbs: (sludge, gal) x (sludge, \% solids) x (8.34 lbs / gal)}$$

$$\text{Lime Required, lbs: (sludge, MG) x (volatile acids, mg/L) x (8.34 lbs / gal)}$$

$$(\text{in} - \text{out})$$

Percent volatile solids reduction:  $\frac{\text{in} - \text{out}}{\text{in}} \times 100 \%$

**HORSEPOWER, FORCE, ELECTRICAL**

$Q(\text{gpm}) \times 8.34 \text{ lbs / gal} \times \text{head (ft)}$

Water HP:  $\frac{\text{Water HP}}{33,000 \text{ ft-lbs/min}}$

Brake HP:  $\frac{\text{Water HP}}{\text{Pump Efficiency}}$

Power: Current x Voltage      Voltage: Current x Resistance

Average Current:  $\frac{\text{Line 1 Current} + \text{Line 2 Current} + \text{Line 3 Current}}{3}$

Current Imbalance:  $\frac{\text{Average Current} - \text{Maximum Deviation} \times 100}{\text{Average Current}}$

Chemical Solution, lbs/gal:  $\frac{(\text{solution } \%) \times (8.34 \text{ lbs/gal})}{100\%}$

Mixed Concentration =  $\frac{(\text{Upstream Flow})(\text{Upstream Concentration}) + (\text{Effluent Flow})(\text{Effluent Concentration})}{(\text{Downstream Flow})}$

**LAB PROCEDURES AND MEASUREMENTS**

TSS, mg/L:  $\frac{\text{Dry Sample (g)}}{\text{Amount of Sample (ml)}} \times \text{conversion factor}$

VSS, mg/L:  $\frac{\text{Dry Sample} - \text{Ash (g)}}{\text{Sample Volume (mL)}} \times \text{conversion factor}$

VSS, %:  $\frac{\text{Volatile Solids (mg/L)}}{\text{Total Suspended Solids (mg/L)}} \times 100 \%$

Wet Sludge – Dry Solids

$$\% \text{ Moisture: } \frac{\text{Wet Sludge}}{\text{Wet Sludge}} \times 100\%$$

$$\text{BOD, mg/L (Initial DO - Final DO)} \times \frac{\text{Bottle Volume (mL)}}{\text{Sample Volume (mL)}}$$

Temperature Conversion:  $^{\circ}\text{F} = (1.8 \times ^{\circ}\text{C}) + 32$   
 $^{\circ}\text{C} = (^{\circ}\text{C} - 32) / 1.8$

Chlorine Demand (mg/L): dosage (mg/L) - residual (mg/L)

**SLUDGE MATH** Gal/acre =  $\frac{\text{lbs}}{\text{acre}}$

$$\frac{\text{lbs}}{\text{acre}} = \frac{\text{Gal/acre}}{(\% \text{PAN})(\% \text{Solids})(8.34)}$$

*this formula sheet edited Aug 2019*

# **SUBJECT BREAKDOWN**

The following is a list of the main subject areas that may be covered on the examinations.

## I. General Information

- A. Characteristics of wastewater
- B. Activated sludge terminology

## II. Collection Systems

- A. Routine operation and maintenance of collection system components
- B. Sewer installation inspections
- C. Troubleshooting collection systems

## III. Pumps and Pumping

- A. Types of pumps and motors and their application
- B. Operation and maintenance
  - 1. Pumps
  - 2. Motors
  - 3. Pump and motor controls
  - 4. Electrical

## IV. Flow Measurement

- A. Instruments
- B. Process controls

## V. Preliminary Treatment

- A. Theory of preliminary treatment
- B. Operation and maintenance
  - 1. Bar screens
  - 2. Barminutors
  - 3. Comminutors
  - 4. Grit chambers

## VI. Primary Treatment

- A. Theory of primary treatment
- B. Operation and maintenance
  - 1. Primary clarifiers
  - 2. Imhoff tanks

VII. Secondary Treatment

- A. Theory of secondary treatment
- B. Operation and Maintenance
  - 1. Lagoons
  - 2. Slow sand filters
  - 3. RBC's
  - 4. Trickling filters
  - 5. Activated sludge units
  - 6. Secondary Sedimentation

VIII. Sludge Handling

- A. Theory of sludge handling
- B. Operation and maintenance
  - 1. Anaerobic digesters
  - 2. Aerobic digesters
  - 3. Sludge drying equipment
    - a. Coil or cloth filters
    - b. Sludge drying beds
    - c. Filter presses
  - 5. Sludge lagoons
  - 6. Sludge thickening equipment
    - a. Flotation devices
    - b. Gravity thickening devices
    - c. Chemical addition and/or conditioning
  - 7. Sludge disposal
    - a. Land application
    - b. Landfill disposal
    - c. Incineration

IX. Tertiary Treatment

- A. Theory of tertiary treatment
- B. Operation and maintenance
  - 1. Polishing ponds
  - 2. Intermittent sand filters
  - 3. Rapid sand filters
  - 4. Microstrainers

X. Disinfection

- A. Theory of disinfection
- B. Operation and maintenance
  - 1. Chlorination systems
  - 2. Other disinfection systems

XI. Laboratory

- A. Process control testing
  - 1. BOD
  - 2. TSS
  - 3. COD
  - 4. Settleable solids
  - 5. Volatile solids
  - 6. Volatile acids
  - 7. Alkalinity
  - 8. F/M ratio
  - 9. Sludge age
  - 10. SVI

- B. NPDES testing
  - 1. pH
  - 2. BOD
  - 3. TSS
  - 4. Chlorine residual
  - 5. Ammonia
  - 6. DO
  - 7. Heavy metals

XII. Safety and Health

- A. Clothing and apparel
- B. Machinery
- C. Chemical handling
- D. Laboratory
- E. Collection systems

XIII. Record Keeping

- A. Plant operations
- B. Laboratory data
- C. Financial data
- D. Maintenance data
- E. Accident data

XIV. Rules and Regulations

- A. 35 Ill. Adm. Code, Subtitle C: Water Pollution
- B. 35 Ill. Adm. Code Part 391 (Design Criteria for Sludge Application on Land)
- C. NPDES
- D. Local ordinances

XV. Lagoons

- A. Purpose of lagoons
- B. Description of lagoons
  - 1. Aerobic lagoons
  - 2. Anaerobic lagoons
  - 3. Facultative lagoons
  - 4. Aerated lagoons
- C. Operation of lagoons
- D. Troubleshooting of lagoons

XVI. Math

- A. Problem solving
- B. Formulas
- C. Process control
  - 1. Volume
  - 2. Area
  - 3. Pounds formula
  - 4. Organic loading
  - 5. Hydraulic loading
  - 6. Detention time
  - 7. Velocity
  - 8. SVI
  - 9. MCRT
  - 10. F/M ratio
  - 11. Sludge age
  - 12. Clarifier math
  - 13. Sludge math
  - 14. Conversions
  - 15. Electrical, horsepower

# PRACTICE QUESTIONS

## I. General Information

- A. Characteristics of wastewater
- B. Activated sludge terminology

Example Questions:

The Hatfield Process is the same as the Kraus Process with the following exception.

- a) 10 to 15% of the return activated sludge stream is re aerated in the presence of anaerobic digester supernatant and digested sludge
- b) 65 to 70% of the return activated sludge stream is re aerated in the presence of anaerobic digester supernatant and digested sludge
- c) 100% of the return activated sludge stream is re aerated in the presence of anaerobic digester supernatant and digested sludge
- d) The Hatfield Process and the Krause Process are not similar enough to compare with only one exception

## II. Collection Systems

- A. Routine operation and maintenance of collection system components
- B. Sewer installation inspections
- C. Troubleshooting collection systems

Example Question:

Below is a set of data or events, reflecting a problem at a pumping station. Wet well inlet Receives dry weather flow; lead pump cycles on at proper wet well level; lag pump cycle on a proper wet well level; wet well level drops after lap pump cycles on; discharge pressure rises after lag pump cycles on. Study the data carefully. Which one of the following is the most probable cause of the problem?

- a) Lead pump's main fuse is blown
- b) Clogged suction line
- c) Lead and lag pumps do not alternate correctly
- d) None of the above

## III. Pumps and Pumping

- A. Types of pumps and motors and their application
- B. Operation and maintenance
  - 1. Pumps
  - 2. Motors

3. Pump and motor controls
4. Electrical

Example Questions:

The discharge piping of a 3 phase induction motor driven centrifugal pump is rerouted such that the TDH against which the pump is pumping is reduced by 50%. This will cause:

- a) the motor to draw more amperage
- b) motor to run cooler
- c) motor to run faster
- d) the motor to draw less amperage

#### IV. Flow Measurement

- A. Instruments
- B. Process controls

Example Questions:

A magnetic flow meter is a:

- a) displacement meter
- b) differential head meter
- c) velocity head meter
- d) none of the above

#### V. Preliminary Treatment

- A. Theory of preliminary treatment
- B. Operation and maintenance
  1. Bar screens
  2. Barminutors
  3. Comminutors
  4. Grit chambers

Example Questions:

Pre-chlorination is not used for:

- a) reduction of BOD
- b) aiding in sedimentation
- c) protection of plant structures
- d) disinfection

VI. Primary Treatment

- A. theory of primary treatment
- B. Operation and maintenance
  - 1. Primary clarifiers
  - 2. Imhoff tanks

Example Questions:

Which of the following is not a typical percentage for primary clarifier removal efficiency? a)

- Bacteria – 25% to 75%
- b) settleable solids – 90% to 95%
- c) Total solids – 60% to 75%
- d) BOD—25% to 35%

VII. Secondary Treatment

- A. Theory of secondary treatment B.
- Operation and Maintenance
  - 1. Lagoons
  - 2. Slow sand filters
  - 3. RBC's
  - 4. Trickling filters
  - 5. Activated sludge units
  - 6. Secondary Sedimentation

Example Question:

Given the following data, describe the action necessary to make the F/M ratio 0.3 assuming 75% volatile solids in the mixed liquor.

Data: Daily flow = 2.0 MGD, Average primary effluent = 120 mg/l, Aeration tank capacity = 500,000 gallons, SVI = 80, RAS concentration = 9,000 mg/l, MLSS = 3,000 mg/l.

- a) Increase sludge wasting
- b) Increase return sludge rate
- c) Decrease sludge wasting
- d) No action is necessary

VIII. Sludge Handling

- A. Theory of sludge handling
- B. Operation and maintenance
  - 1. Anaerobic digesters
  - 2. Aerobic digesters
  - 3. Sludge drying equipment
    - a. Coil or cloth filters
    - b. Sludge drying beds

- c. Filter presses
- d. Sludge lagoons
- 4. Sludge thickening equipment
  - a. Flotation devices
  - b. Gravity thickening devices
  - c. Chemical addition and/or conditioning
- 5. Sludge disposal
  - a. Land application
  - b. Landfill disposal
  - c. Incineration

Example Question:

The maximum temperature change an anaerobic digester should undergo per 24-hour Period should be:

- a) 0.5 degree F
- b) 2 degrees F
- c) 5 degrees F
- d) none of the above

#### IX. Tertiary Treatment

- A. Theory of tertiary treatment
- B. Operation and maintenance
  - 1. Polishing ponds
  - 2. Intermittent sand filters
  - 3. Rapid sand filters
  - 4. Microstrainers

Example Questions:

Anaerobic conditions in an intermittent sand filter:

- a) are normal
- b) Will have little effect on effluent quality
- c) Will have a significant effect on effluent quality
- d) Can be controlled by occasionally flooding filter

#### X. Disinfection

- A. Theory of disinfection
- B. Operation and maintenance
  - 1. Chlorination systems
  - 2. Other disinfection systems

Example Question:

Which of the following is most potent disinfecting agent?

- a) Chlorine
- b) hypochlorous acid
- c) chloramines
- d) All of the above disinfect equally

XI. Laboratory

A. Process control testing

- |        |                      |                |
|--------|----------------------|----------------|
| 1. BOD | 5. Settleable solids | 8. Alkalinity  |
| 2. TSS | 6. Volatile solids   | 9. F/M ratio   |
| 3. COD | 7. Volatile acids    | 10. Sludge age |
| 4. SVI |                      |                |

B. NPDES testing

- |                      |                 |
|----------------------|-----------------|
| 1. pH                | 5. Ammonia      |
| 2. BOD               | 6. DO           |
| 3. TSS               | 7. Heavy metals |
| 4. Chlorine residual |                 |

Example Question:

If it takes 15 ml of 0.10 N H<sub>2</sub>SO<sub>4</sub> to run a total alkalinity test using 100 ml sample, the total alkalinity, as CaCO<sub>3</sub> is:

- a) 7,500 mg/l
- b) 750 mg/l
- c) 75 mg/l
- d) 7.5 mg/l

XII. Safety and Health

- A. Clothing and apparel
- B. Machinery
- C. Chemical handling
- D. Laboratory
- E. Collection systems

Example Question:

Of the following items, what is the first thing the operator should do before he places his hand inside a pump volute to clear an obstruction?

- a) Make sure he has the proper tools to do the job
- b) Trip and lock out the circuit breaker
- c) Flush and drain the pump
- d) Put on rubber gloves

### XIII. Record Keeping

- A. Plant operations
- B. Laboratory data
- C. Financial data
- D. Maintenance data
- E. Accident data

Example Question:

According to NPDES permit requirements, which of the following records are required to be kept?

- a) personnel records
- b) laboratory quality assurance records
- c) purchase orders
- d) annual operation and maintenance reports

### XIV. Rules and Regulations

- A. 35 Ill. Adm. Code, Subtitle C: Water Pollution
- B. 35 Ill. Adm. Code Part 391 (Design Criteria For Sludge Application On Land)
- C. NPDES
- D. Local ordinances

Example Question:

A treatment facility is meeting effluent limits, however, it may be contributing to a violation of:

- a) nothing
- b) a BOD water quality standard
- c) a DO water quality standard
- d) a pH water quality standard

### XV. Mathematics

- A. General math
- B. Process control math
- C. Laboratory math

Example Question:

Given the following data, calculate the influent flow rate.

Data: MLSS = 2,800 mg/l, MLVSS = 2,000 mg/l, Return sludge concentration = 9,200 mg/l, RAS flow rate 3.0 MGD.

- a) 5.8 MGD
- b) 6.9 MGD
- c) 7.6 MGD
- d) none of the above